

# Appendices

## Appendix A1 – Original Dataset

| Institution                      |    | Alumni | Award | HiCi  | PCP  | Empl | Intrn | Tchn | Access |
|----------------------------------|----|--------|-------|-------|------|------|-------|------|--------|
| University of Vienna             | AT | 13,4   | 0     | 21,04 | 26,9 | 6    | 3     | 42,6 | 1      |
| Ghent University                 | BE | 5,1    | 13,1  | 39,5  | 36,7 | 5    | 2     | 44,4 | 2      |
| Catholic University of Leuven    | BE | 0      | 0     | 33,2  | 31,2 | 8    | 3     | 54,2 | 2      |
| Catholic University of Louvain   | BE | 10,2   | 13,1  | 19,2  | 27,1 | 7    | 3     | 38,9 | 2      |
| Free University of Brussels      | BE | 19,7   | 26,3  | 0     | 32   | 7    | 3     | 32,4 | 2      |
| University of Copenhagen         | DK | 21,5   | 18,6  | 33,2  | 42,9 | 6    | 3     | 44   | 2      |
| Aarhus University                | DK | 11,4   | 21,8  | 19,2  | 33,4 | 6    | 3     | 37,3 | 2      |
| Technical University of Denmark  | DK | 5,1    | 11,4  | 16,6  | 24,6 | 4    | 3     | 35,9 | 2      |
| University of Helsinki           | FI | 18,3   | 20,8  | 28,7  | 34,2 | 6    | 2     | 45,7 | 1      |
| Sorbonne University              | FR | 33,3   | 27,1  | 25,3  | 26,2 | 8    | 1     | 49,3 | 2      |
| University of Paris-Sud          | FR | 30     | 53,6  | 19,2  | 33,4 | 4    | 2     | 40,4 | 2      |
| Ecole Normale Supérieure - Paris | FR | 48,4   | 27,6  | 0     | 84,8 | 8    | 3     | 40,1 | 2      |
| Aix Marseille University         | FR | 13,4   | 0     | 23,5  | 19,7 | 1    | 1     | 40,2 | 2      |
| University of Strasbourg         | FR | 28,3   | 33,1  | 0     | 22,1 | 1    | 2     | 29,9 | 2      |
| University Paris Diderot         | FR | 11,4   | 9,3   | 16,6  | 24,7 | 1    | 1     | 30,2 | 2      |
| Université Grenoble Alpes        | FR | 0      | 14,7  | 0     | 20,5 | 2    | 1     | 30,9 | 2      |
| Heidelberg University            | DE | 19,7   | 25    | 28,7  | 35,6 | 8    | 2     | 63,6 | 3      |
| Technical University Munich      | DE | 36,6   | 21,3  | 25,3  | 35,5 | 10   | 2     | 60,3 | 3      |
| University of Munich             | DE | 28,3   | 18,9  | 23,5  | 34,9 | 9    | 2     | 65,4 | 3      |
| University of Bonn               | DE | 15,2   | 19,5  | 21,4  | 26,6 | 3    | 1     | 47,3 | 3      |

|                                                |    |      |      |      |      |    |   |      |   |
|------------------------------------------------|----|------|------|------|------|----|---|------|---|
| University of Frankfurt                        | DE | 30   | 0    | 16,6 | 25,7 | 6  | 1 | 32,5 | 3 |
| University of Freiburg                         | DE | 22,1 | 18,6 | 16,6 | 25   | 4  | 2 | 47,1 | 3 |
| TU Dresden                                     | DE | 0    | 0    | 21,4 | 25,1 | 8  | 1 | 42,8 | 3 |
| University of Cologne                          | DE | 0    | 11,4 | 9,6  | 2,9  | 7  | 1 | 39,8 | 3 |
| University of Hamburg                          | DE | 11,4 | 0    | 16,6 | 23,9 | 5  | 1 | 43,5 | 3 |
| Trinity College Dublin                         | IE | 15,2 | 13,1 | 16,6 | 21,6 | 7  | 3 | 45,3 | 1 |
| University of Milan                            | IT | 16,8 | 0    | 13,5 | 23,3 | 4  | 1 | 34,1 | 3 |
| Utrecht University                             | NL | 22,7 | 19,7 | 35,8 | 29,3 | 5  | 2 | 45,5 | 3 |
| University of Groningen                        | NL | 13,4 | 25,2 | 19,2 | 33,7 | 4  | 3 | 40,7 | 3 |
| Leiden University                              | NL | 17,6 | 9,3  | 28,7 | 33   | 5  | 2 | 44,6 | 3 |
| Erasmus University Rotterdam                   | NL | 0    | 14,7 | 48,8 | 40,2 | 8  | 2 | 38,9 | 3 |
| Radboud University Nijmegen                    | NL | 16,1 | 0    | 19,2 | 36,2 | 2  | 2 | 33,9 | 3 |
| University of Amsterdam                        | NL | 5,1  | 0    | 25,3 | 28,5 | 7  | 2 | 51,3 | 3 |
| University of Wageningen                       | NL | 0    | 0    | 28,7 | 35,1 | 4  | 1 | 46,6 | 3 |
| VU University Amsterdam                        | NL | 0    | 0    | 33,2 | 35,2 | 5  | 2 | 32,5 | 3 |
| Delft University of Technology                 | NL | 11,4 | 0    | 13,5 | 24,8 | 10 | 3 | 53,4 | 3 |
| University of Oslo                             | NO | 27,8 | 32,2 | 13,5 | 28,6 | 5  | 3 | 36   | 1 |
| Norwegian University of Science and Technology | NO | 13,4 | 20,8 | 19,2 | 20,5 | 5  | 3 | 30,7 | 1 |
| University of Lisbon                           | PT | 0    | 8    | 9,6  | 26   | 7  | 1 | 24   | 1 |
| University of Barcelona                        | ES | 0    | 0    | 27,1 | 23,2 | 7  | 1 | 32,4 | 2 |
| Karolinska Institute                           | SE | 25,4 | 26,3 | 25,3 | 48,6 | 8  | 3 | 57   | 2 |
| Uppsala University                             | SE | 17,6 | 27,1 | 16,6 | 29,5 | 5  | 2 | 42,9 | 2 |
| Stockholm University                           | SE | 23,8 | 27,1 | 16,6 | 27,4 | 3  | 2 | 33,1 | 2 |
| Lund University                                | SE | 20,9 | 0    | 16,6 | 23,6 | 8  | 3 | 40,8 | 2 |

## Appendix A2 – Criteria Scores before Modification

| Institution                      | Country | Empl | Intrn | Access |
|----------------------------------|---------|------|-------|--------|
| University of Vienna             | AT      | 51,2 | 97,1  | 72,1   |
| Ghent University                 | BE      | 47,3 | 49,7  | 83,5   |
| Catholic University of Leuven    | BE      | 78   | 84,8  | 83,5   |
| Catholic University of Louvain   | BE      | 63   | 88,7  | 83,5   |
| Free University of Brussels      | BE      | 67   | 79,4  | 83,5   |
| University of Copenhagen         | DK      | 54,2 | 84,9  | 78,1   |
| Aarhus University                | DK      | 54,6 | 72,1  | 78,1   |
| Technical University of Denmark  | DK      | 38,5 | 99,2  | 78,1   |
| University of Helsinki           | FI      | 51,4 | 53,6  | 73     |
| Sorbonne University              | FR      | 78,8 | 24,4  | 82,5   |
| University of Paris-Sud          | FR      | 34   | 42,5  | 82,5   |
| Ecole Normale Supérieure - Paris | FR      | 78,6 | 94,4  | 82,5   |
| Aix Marseille University         | FR      | 8    | 26,3  | 82,5   |
| University of Strasbourg         | FR      | 9,3  | 35,7  | 82,5   |
| University Paris Diderot         | FR      | 5    | 21,3  | 82,5   |
| Université Grenoble Alpes        | FR      | 10,3 | 20,9  | 82,5   |
| Heidelberg University            | DE      | 76,5 | 50,5  | 97,1   |
| Technical University Munich      | DE      | 98,7 | 53    | 97,1   |
| University of Munich             | DE      | 88,2 | 54,8  | 97,1   |
| University of Bonn               | DE      | 22,2 | 30,5  | 97,1   |
| University of Frankfurt          | DE      | 58,4 | 18,2  | 97,1   |
| University of Freiburg           | DE      | 37,8 | 56,2  | 97,1   |
| TU Dresden                       | DE]     | 77   | 31,2  | 97,1   |
| University of Cologne            | DE      | 62,4 | 26,7  | 97,1   |
| University of Hamburg            | DE      | 44   | 23    | 97,1   |
| Trinity College Dublin           | IE      | 68,9 | 98,4  | 71,6   |
| University of Milan              | IT      | 36,4 | 11,5  | 93,3   |
| Utrecht University               | NL      | 43,6 | 57,2  | 87,7   |
| University of Groningen          | NL      | 36,3 | 89,7  | 87,7   |
| Leiden University                | NL      | 42,1 | 69,2  | 87,7   |
| Erasmus University Rotterdam     | NL      | 70,3 | 62,1  | 87,7   |
| Radboud University Nijmegen      | NL      | 13,4 | 44,7  | 87,7   |
| University of Amsterdam          | NL      | 66,1 | 75,4  | 87,7   |
| University of Wageningen         | NL      | 35,3 | 32,8  | 87,7   |
| VU University Amsterdam          | NL      | 43,5 | 38,2  | 87,7   |
| Delft University of Technology   | NL      | 91   | 97,7  | 87,7   |
| University of Oslo               | NO      | 41,5 | 78,4  | 65,8   |

|                                                |    |      |      |      |
|------------------------------------------------|----|------|------|------|
| Norwegian University of Science and Technology | NO | 47,9 | 72   | 65,8 |
| University of Lisbon                           | PT | 61   | 9    | 73,7 |
| University of Barcelona                        | ES | 60,7 | 6,4  | 81,1 |
| Karolinska Institute                           | SE | 75,7 | 88,7 | 83,4 |
| Uppsala University                             | SE | 49,4 | 46,7 | 83,4 |
| Stockholm University                           | SE | 20,3 | 64,3 | 83,4 |
| Lund University                                | SE | 71,8 | 88,3 | 83,4 |

## Appendix A3 – University Ranking Survey

University:

Programme:

Please circle the most satisfying answer.

1. What is your gender?

Female

Male

2. Please select your age category.

18-21

22-25

25-28

28+

3. Which group of factors is the most significant for selection of higher institution?

Academic quality (citations, field prizes and medals...)

Teaching quality (employments rates of graduates, international lecturers...)

4. How important are the alumni academic achievements of a given institution (Nobel Prizes, Field Medals...)?

0 = Not important at all

1= Of Little Importance

2= Of Average Importance

3= Very Important

4= Absolutely Essential

5. How decisive is the academic success of staff for selection of education institution?

0 = Not important at all

1= Of Little Importance

2= Of Average Importance

- 3= Very Important
- 4= Absolutely Essential

6. Considering high citation frequency of university publications, how likely are you to favour this university?

- 0= Not at All
- 1= Very Little
- 2= Somewhat
- 3= To a Great Extent
- 4= Definitely

7. To what extend per capita academic importance of an institution (overall academic accomplishment divided by the total number of full-time academic staff) is significant for enrolee?

- 0 = Not important at all
- 1= Of Little Importance
- 2= Of Average Importance
- 3= Very Important
- 4= Absolutely Essential

8. Future employment perspective is crucial selection factor when choosing educational institution, isn't it?

- 0= Strongly Disagree
- 1= Disagree
- 2= Undecided
- 3= Agree
- 4= Strongly Agree

9. Can strong international ties of a faculty be recognized as a privilege for an enrolee?

- 0= Strongly Disagree
- 1= Disagree
- 2= Undecided
- 3= Agree
- 4= Strongly Agree

10. Will institution's commitment and teaching quality be conclusive in selection process?

- 0= Definitely Won't
- 1= Probably Won't
- 2= Undecided
- 3= Probably Will

4= Definitely Will

11. Are you likely to choose an education institution based on the amount of places available?

0= Definitely Not

1= Probably Not

2= Undecided

3= Very Probably

4= Definitely

## Appendix A4 – Survey Results

|                  |               | Alumni | Award | HiCi | PCP | Empl | Intrn | Tchn | Access |
|------------------|---------------|--------|-------|------|-----|------|-------|------|--------|
| Social Sciences  | <i>Female</i> | 20     | 27    | 22   | 24  | 31   | 31    | 33   | 24     |
|                  | <i>Male</i>   | 20     | 23    | 16   | 26  | 35   | 29    | 33   | 13     |
| <b>Total</b>     |               | 40     | 50    | 38   | 50  | 66   | 60    | 66   | 37     |
| Natural Sciences | <i>Female</i> | 24     | 31    | 24   | 27  | 36   | 27    | 36   | 16     |
|                  | <i>Male</i>   | 21     | 27    | 23   | 20  | 30   | 4     | 34   | 17     |
| <b>Total</b>     |               | 45     | 58    | 47   | 47  | 66   | 31    | 70   | 33     |
| Applied Sciences | <i>Female</i> | 21     | 26    | 24   | 21  | 36   | 30    | 35   | 23     |
|                  | <i>Male</i>   | 21     | 24    | 18   | 22  | 33   | 29    | 31   | 18     |
| <b>Total</b>     |               | 42     | 50    | 42   | 43  | 69   | 59    | 66   | 41     |
| Formal Sciences  | <i>Female</i> | 15     | 27    | 17   | 24  | 33   | 29    | 35   | 17     |
|                  | <i>Male</i>   | 16     | 17    | 26   | 20  | 35   | 30    | 32   | 15     |
| <b>Total</b>     |               | 31     | 44    | 43   | 44  | 68   | 59    | 67   | 32     |

|        |    |     |    |    |     |     |     |    |
|--------|----|-----|----|----|-----|-----|-----|----|
| Female | 80 | 111 | 87 | 96 | 136 | 117 | 139 | 80 |
| Male   | 78 | 91  | 83 | 88 | 133 | 92  | 130 | 63 |

## Appendix A5 – Rankings

### The final rank by gender

| Institution                      | Country | Female      |              | Male        |              |
|----------------------------------|---------|-------------|--------------|-------------|--------------|
|                                  |         | $\bar{r}_j$ | Overall Rank | $\bar{r}_j$ | Overall Rank |
| University of Vienna             | AT      | 21,67       | 24           | 23,33       | 25           |
| Ghent University                 | BE      | 17,67       | 15-16        | 22,33       | 23           |
| Catholic University of Leuven    | BE      | 12,33       | 10           | 14,33       | 13           |
| Catholic University of Louvain   | BE      | 16,33       | 14           | 12,00       | 9-10         |
| Free University of Brussels      | BE      | 26,67       | 28           | 18,67       | 16           |
| University of Copenhagen         | DK      | 8,00        | 5-6          | 11,00       | 7-8          |
| Aarhus University                | DK      | 17,67       | 15-16        | 14,00       | 11-12        |
| Technical University of Denmark  | DK      | 28,00       | 30           | 29,67       | 31           |
| University of Helsinki           | FI      | 11,33       | 9            | 14,00       | 11-12        |
| Sorbonne University              | FR      | 8,00        | 5-6          | 6,33        | 5            |
| University of Paris-Sud          | FR      | 18,00       | 17           | 19,33       | 17-18-19     |
| Ecole Normale Supérieure - Paris | FR      | 13,33       | 11           | 11,00       | 7-8          |
| Aix Marseille University         | FR      | 40,00       | 40           | 43,33       | 44           |
| University of Strasbourg         | FR      | 40,33       | 41-42-43     | 41,00       | 41-42        |
| University Paris Diderot         | FR      | 39,00       | 38           | 40,33       | 40           |
| Université Grenoble Alpes        | FR      | 43,00       | 44           | 42,00       | 43           |
| Heidelberg University            | DE      | 4,00        | 4            | 3,67        | 4            |
| Technical University Munich      | DE      | 2,00        | 2            | 1,33        | 1            |
| University of Munich             | DE      | 2,67        | 3            | 3,00        | 3            |
| University of Bonn               | DE      | 25,33       | 26           | 32,00       | 32-33-34     |
| University of Frankfurt          | DE      | 38,00       | 37           | 32,00       | 32-33-34     |
| University of Freiburg           | DE      | 19,67       | 21-22        | 27,67       | 29-30        |
| TU Dresden                       | DE]     | 26,00       | 27           | 21,33       | 22           |
| University of Cologne            | DE      | 30,33       | 32           | 23,00       | 24           |
| University of Hamburg            | DE      | 32,67       | 34           | 34,33       | 37           |
| Trinity College Dublin           | IE      | 9,00        | 7            | 9,67        | 6            |
| University of Milan              | IT      | 40,33       | 41-42-43     | 39,00       | 39           |
| Utrecht University               | NL      | 13,67       | 12           | 19,67       | 20           |
| University of Groningen          | NL      | 19,00       | 19           | 24,67       | 28           |
| Leiden University                | NL      | 19,67       | 21-22        | 23,67       | 26           |
| Erasmus University Rotterdam     | NL      | 20,00       | 23           | 14,67       | 14           |

|                                                |    |       |          |       |          |
|------------------------------------------------|----|-------|----------|-------|----------|
| Radboud University Nijmegen                    | NL | 39,33 | 39       | 41,00 | 41-42    |
| University of Amsterdam                        | NL | 15,00 | 13       | 19,33 | 17-18-19 |
| University of Wageningen                       | NL | 30,00 | 31       | 36,67 | 38       |
| VU University Amsterdam                        | NL | 34,33 | 35       | 33,33 | 36       |
| Delft University of Technology                 | N  | 11,00 | 8        | 12,00 | 9-10     |
| University of Oslo                             | NO | 22,00 | 25       | 19,33 | 17-18-19 |
| Norwegian University of Science and Technology | NO | 27,00 | 29       | 24,00 | 27       |
| University of Lisbon                           | PT | 40,33 | 41-42-43 | 32,00 | 32-33-34 |
| University of Barcelona                        | ES | 36,33 | 36       | 27,67 | 29-30    |
| Karolinska Institute                           | SE | 1,33  | 1        | 2,00  | 2        |
| Uppsala University                             | SE | 19,33 | 20       | 20,67 | 21       |
| Stockholm University                           | SE | 31,67 | 33       | 32,67 | 35       |
| Lund University                                | SE | 18,67 | 18       | 17,00 | 15       |

### The final rank by the field of study

| Institution                      | Country | Social Sciences |              | Natural Sciences |              |
|----------------------------------|---------|-----------------|--------------|------------------|--------------|
|                                  |         | $\bar{r}_j$     | Overall Rank | $\bar{r}_j$      | Overall Rank |
| University of Vienna             | AT      | 21              | 22-23        | 29               | 30-31        |
| Ghent University                 | BE      | 20,333          | 21           | 14,667           | 14           |
| Catholic University of Leuven    | BE      | 12,667          | 11           | 13,333           | 11           |
| Catholic University of Louvain   | BE      | 13,333          | 12           | 21,667           | 22-23        |
| Free University of Brussels      | BE      | 23,667          | 26           | 29               | 30-31        |
| University of Copenhagen         | DK      | 9               | 6-7          | 10               | 6-7          |
| Aarhus University                | DK      | 16              | 13-14-15     | 21,667           | 22-23        |
| Technical University of Denmark  | DK      | 28              | 30           | 30,667           | 33           |
| University of Helsinki           | FI      | 12              | 9            | 10               | 6-7          |
| Sorbonne University              | FR      | 8,667           | 5            | 5                | 5            |
| University of Paris-Sud          | FR      | 21              | 22-23        | 12,667           | 10           |
| Ecole Normale Supérieure - Paris | FR      | 12,333          | 10           | 14,333           | 13           |
| Aix Marseille University         | FR      | 42,667          | 43           | 39               | 39-40        |
| University of Strasbourg         | FR      | 40,333          | 42           | 40,333           | 42           |
| University Paris Diderot         | FR      | 39,667          | 39-40        | 38               | 38           |
| Université Grenoble Alpes        | FR      | 43              | 44           | 43               | 44           |



|                                                |     |        |          |        |       |
|------------------------------------------------|-----|--------|----------|--------|-------|
| Heidelberg University                          | DE  | 4      | 4        | 2      | 2     |
| Technical University Munich                    | DE  | 1,333  | 1        | 1,333  | 1     |
| University of Munich                           | DE  | 3      | 3        | 2,667  | 3     |
| University of Bonn                             | DE  | 30,667 | 31       | 21     | 20    |
| University of Frankfurt                        | DE  | 34,333 | 35-36    | 34,667 | 35    |
| University of Freiburg                         | DE  | 24,667 | 27       | 17     | 17-18 |
| TU Dresden                                     | DE] | 23,333 | 25       | 22,667 | 25    |
| University of Cologne                          | DE  | 27,333 | 29       | 27,667 | 29    |
| University of Hamburg                          | DE  | 32     | 33       | 30,333 | 31-32 |
| Trinity College Dublin                         | IE  | 9      | 6-7      | 13,667 | 12    |
| University of Milan                            | IT  | 39,667 | 39-40    | 39     | 39-40 |
| Utrecht University                             | NL  | 16,667 | 16       | 10,667 | 8     |
| University of Groningen                        | NL  | 21,667 | 24       | 22,333 | 24    |
| Leiden University                              | NL  | 19,333 | 20       | 17     | 17-18 |
| Erasmus University Rotterdam                   | NL  | 18,667 | 17       | 18     | 19    |
| Radboud University Nijmegen                    | NL  | 40     | 41       | 41     | 43    |
| University of Amsterdam                        | NL  | 16     | 13-14-15 | 15,333 | 15    |
| University of Wageningen                       | NL  | 35     | 37       | 27     | 28    |
| VU University Amsterdam                        | NL  | 34,333 | 35-36    | 36,667 | 37    |
| Delft University of Technology                 | N   | 11,333 | 8        | 12     | 9     |
| University of Oslo                             | NO  | 19     | 18-19    | 24,667 | 27    |
| Norwegian University of Science and Technology | NO  | 26,667 | 28       | 31,667 | 34    |
| University of Lisbon                           | PT  | 37     | 38       | 39,667 | 41    |
| University of Barcelona                        | ES  | 33,333 | 34       | 35,333 | 36    |
| Karolinska Institute                           | SE  | 1,667  | 2        | 4      | 4     |
| Uppsala University                             | SE  | 19     | 18-19    | 16,667 | 16    |
| Stockholm University                           | SE  | 31,333 | 32       | 30,333 | 31-32 |
| Lund University                                | SE  | 16     | 13-14-15 | 23,333 | 26    |

| Institution                   | Country | Formal Sciences |              | Applied Sciences |              |
|-------------------------------|---------|-----------------|--------------|------------------|--------------|
|                               |         | $\bar{r}_j$     | Overall Rank | $\bar{r}_j$      | Overall Rank |
| University of Vienna          | AT      | 22              | 22           | 22,333           | 23-24        |
| Ghent University              | BE      | 21              | 20           | 22,333           | 23-24        |
| Catholic University of Leuven | BE      | 12,667          | 11           | 13,000           | 11           |
| Catholic University of        | BE      | 10,667          | 7-8          | 11,000           | 8-9          |

|                                                |    |        |       |        |       |
|------------------------------------------------|----|--------|-------|--------|-------|
| Louvain                                        |    |        |       |        |       |
| Free University of Brussels                    | BE | 20     | 19    | 19,667 | 19    |
| University of Copenhagen                       | DK | 11     | 9     | 10,667 | 7     |
| Aarhus University                              | DK | 13,333 | 12    | 13,667 | 12    |
| Technical University of Denmark                | DK | 29,333 | 31    | 29,667 | 32    |
| University of Helsinki                         | FI | 15     | 13-14 | 14,667 | 13    |
| Sorbonne University                            | FR | 10     | 6     | 9,333  | 6     |
| University of Paris-Sud                        | FR | 25,333 | 28    | 23,000 | 25    |
| Ecole Normale Supérieure - Paris               | FR | 12,333 | 10    | 11,667 | 10    |
| Aix Marseille University                       | FR | 42,667 | 43-44 | 43,000 | 44    |
| University of Strasbourg                       | FR | 41,667 | 42    | 41,000 | 42    |
| University Paris Diderot                       | FR | 40,333 | 41    | 40,333 | 40    |
| Université Grenoble Alpes                      | FR | 42,667 | 43-44 | 42,667 | 43    |
| Heidelberg University                          | DE | 4,333  | 4     | 4,333  | 4     |
| Technical University Munich                    | DE | 1      | 1     | 1,000  | 1     |
| University of Munich                           | DE | 2,667  | 3     | 2,667  | 3     |
| University of Bonn                             | DE | 32,333 | 34-35 | 32,667 | 37    |
| University of Frankfurt                        | DE | 31,667 | 32-33 | 32,000 | 33-34 |
| University of Freiburg                         | DE | 28,667 | 30    | 28,333 | 30-31 |
| TU Dresden                                     | DE | 21,667 | 21    | 21,667 | 22    |
| University of Cologne                          | DE | 24     | 26-27 | 24,333 | 29    |
| University of Hamburg                          | DE | 34,333 | 37    | 34,333 | 37    |
| Trinity College Dublin                         | IE | 9      | 5     | 8,667  | 5     |
| University of Milan                            | IT | 38,667 | 39    | 39,000 | 39    |
| Utrecht University                             | NL | 18,333 | 17    | 19,333 | 18    |
| University of Groningen                        | NL | 23,333 | 25    | 24,000 | 28    |
| Leiden University                              | NL | 22,667 | 24    | 23,333 | 26-27 |
| Erasmus University Rotterdam                   | NL | 15     | 13-14 | 15,667 | 15    |
| Radboud University Nijmegen                    | NL | 40     | 40    | 40,667 | 41    |
| University of Amsterdam                        | NL | 17     | 16    | 17,667 | 16-17 |
| University of Wageningen                       | NL | 36,333 | 38    | 36,667 | 38    |
| VU University Amsterdam                        | NL | 31,667 | 32-33 | 32,333 | 35-36 |
| Delft University of Technology                 | N  | 10,667 | 7-8   | 11,000 | 8-9   |
| University of Oslo                             | NO | 19     | 18    | 17,667 | 16-17 |
| Norwegian University of Science and Technology | NO | 24     | 26-27 | 23,333 | 26-27 |
| University of Lisbon                           | PT | 32,333 | 34-35 | 32,333 | 35-36 |

|                         |    |        |    |        |       |
|-------------------------|----|--------|----|--------|-------|
| University of Barcelona | ES | 28     | 29 | 28,333 | 30-31 |
| Karolinska Institute    | SE | 2,333  | 2  | 2,333  | 2     |
| Uppsala University      | SE | 22,333 | 23 | 21,000 | 20    |
| Stockholm University    | SE | 33     | 36 | 32,000 | 33-34 |
| Lund University         | SE | 15,667 | 15 | 15,333 | 14    |

## Appendix A6 – Efficiency testing (RStudio output)

| Institution                      | Efficiency |
|----------------------------------|------------|
| University of Vienna             | 1          |
| Ghent University                 | 0,8108     |
| Catholic University of Leuven    | 1          |
| Catholic University of Louvain   | 1          |
| Free University of Brussels      | 1          |
| University of Copenhagen         | 1          |
| Aarhus University                | 1          |
| Technical University of Denmark  | 1          |
| University of Helsinki           | 1          |
| Sorbonne University              | 0,9517     |
| University of Paris-Sud          | 0,7479     |
| Ecole Normale Supérieure - Paris | 1          |
| Aix Marseille University         | 1          |
| University of Strasbourg         | 1          |
| University Paris Diderot         | 0,6124     |
| Université Grenoble Alpes        | 1          |
| Heidelberg University            | 1          |
| Technical University Munich      | 1          |
| University of Munich             | 1          |
| University of Bonn               | 0,8517     |
| University of Frankfurt          | 0,608      |
| University of Freiburg           | 0,8781     |
| TU Dresden                       | 1          |
| University of Cologne            | 1          |
| University of Hamburg            | 0,8577     |
| Trinity College Dublin           | 1          |
| University of Milan              | 1          |
| Utrecht University               | 0,7772     |

|                                                |        |
|------------------------------------------------|--------|
| University of Groningen                        | 1      |
| Leiden University                              | 0,7622 |
| Erasmus University Rotterdam                   | 1      |
| Radboud University Nijmegen                    | 0,6667 |
| University of Amsterdam                        | 0,9524 |
| University of Wageningen                       | 0,9348 |
| VU University Amsterdam                        | 0,6667 |
| Delft University of Technology                 | 1      |
| University of Oslo                             | 1      |
| Norwegian University of Science and Technology | 1      |
| University of Lisbon                           | 1      |
| University of Barcelona                        | 1      |
| Karolinska Institute                           | 1      |
| Uppsala University                             | 0,8337 |
| Stockholm University                           | 0,6667 |
| Lund University                                | 1      |

## Appendix A7 – DEA Calculation

| University of Frankfurt | Catholic University of Leuven* |           |       | Delft University of Technology* |           |        | Total Sum | Current Scores | $\Delta$ |
|-------------------------|--------------------------------|-----------|-------|---------------------------------|-----------|--------|-----------|----------------|----------|
|                         | Values                         | $\lambda$ | Total | Values                          | $\lambda$ | Total  |           |                |          |
| ALUMNI                  | 0,000                          | 0,066     | 0,000 | 11,400                          | 0,934     | 10,649 | 10,65     | 30,00          | 19,35    |
| AWARD                   | 0,000                          | 0,066     | 0,000 | 0,000                           | 0,934     | 0,000  | 0,00      | 0,00           | 0,00     |
| HiCi                    | 33,200                         | 0,066     | 2,188 | 13,500                          | 0,934     | 12,610 | 14,80     | 16,60          | 1,80     |
| PCP                     | 31,200                         | 0,066     | 2,056 | 24,800                          | 0,934     | 23,166 | 25,22     | 25,70          | 0,48     |
| EMPL                    | 8,000                          | 0,066     | 0,527 | 10,000                          | 0,934     | 9,341  | 9,87      | 6,00           | -3,87    |
| INTRN                   | 3,000                          | 0,066     | 0,198 | 3,000                           | 0,934     | 2,802  | 3,00      | 1,00           | -2,00    |
| TCHNG                   | 54,200                         | 0,066     | 3,572 | 53,400                          | 0,934     | 49,881 | 53,45     | 32,50          | -20,95   |
| ACCESS                  | 2,000                          | 0,066     | 0,132 | 3,000                           | 0,934     | 2,802  | 2,93      | 3,00           | 0,07     |

\* Closest universities that appear on efficiency frontier in comparison to University of Frankfurt.

## Appendix A8 – RStudio Code

```
#####
#----- TOPSIS -----#
#####

rm(list=ls()) #clear environment

if (!require(MCDM)){install.packages("MCDM")}
library (MCDM)

d<- matrix(c( 13.4, 5.1, 0, 10.2, 19.7, 21.5, 11.4, 5.1, 18.3, 33.3, 30, 48.4, 13.4, 28.3, 11.4, 0, 19.7,
              36.6, 28.3, 15.2, 30, 22.1, 0, 0, 11.4, 15.2, 16.8, 22.7, 13.4, 17.6, 0, 16.1, 5.1, 0, 0, 11.4, 27.8, 13.4, 0, 0,
              25.4, 17.6, 23.8, 20.9,
              0, 13.1, 0, 13.1, 26.3, 18.6, 21.8, 11.4, 20.8, 27.1, 53.6, 27.6, 0, 33.1, 9.3, 14.7, 25, 21.3,
              18.9, 19.5, 0, 18.6, 0, 11.4, 0, 13.1, 0, 19.7, 25.2, 9.3, 14.7, 0, 0, 0, 0, 0, 32.2,
              20.8, 8, 0, 26.3, 27.1, 27.1, 0, 21.4, 39.5, 33.2, 19.2, 0, 33.2, 19.2, 16.6, 28.7, 25.3, 19.2,
              0, 23.5, 0, 16.6, 0, 28.7, 25.3, 23.5, 21.4, 16.6, 16.6, 21.4, 9.6,
              16.6, 16.6, 13.5, 35.8, 19.2, 28.7, 48.8, 19.2, 25.3, 28.7, 33.2, 13.5, 13.5,
              19.2, 9.6, 27.1, 25.3, 16.6, 16.6, 16.6, 26.9, 36.7, 31.2, 27.1, 32, 42.9, 33.4, 24.6,
              34.2, 26.2, 33.4, 84.8, 19.7, 22.1, 24.7, 20.5, 35.6, 35.5, 34.9, 26.6, 25.7, 25, 25.1,
              22.9, 23.9, 21.6, 23.3, 29.3, 33.7, 33, 40.2, 36.2, 28.5, 35.1, 35.2, 24.8,
              28.6, 20.5, 26, 23.2, 48.6, 29.5, 27.4, 23.6, 6, 5, 8, 7, 7, 6, 6, 4, 6, 8,
              4, 8, 1, 1, 1, 2, 8, 10, 9, 3, 6, 4, 8, 7, 5, 7, 4, 5, 4, 5, 8, 2, 7, 4, 5, 10,
              5, 5, 7, 7, 8, 5, 3, 8, 3, 2, 3, 3, 3, 3, 3, 2, 1, 2, 3, 1, 2, 1, 1, 2, 2, 2, 1, 1,
              2, 1, 1, 1, 3, 1, 2, 3, 2, 2, 2, 2, 1, 2, 3, 3, 3, 1, 1, 3, 2, 2, 3, 42.6, 44.4,
              54.2, 38.9, 32.4, 44, 37.3, 35.9, 45.7, 49.3, 40.4, 40.1, 40.2, 29.9, 30.2, 30.9,
              63.6, 60.3, 65.4, 47.3, 32.5, 47.1, 42.8, 39.8, 43.5, 45.3, 34.1, 45.5, 40.7, 44.6, 38.9,
              33.9, 51.3, 46.6, 32.5, 53.4, 36, 30.7, 24, 32.4, 57, 42.9, 33.1, 40.8, 1, 2, 2, 2, 2,
              2, 2, 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 1, 3, 3, 3, 3, 3, 3, 3, 3, 3,
              1, 1, 1, 2, 2, 2, 2, 2),nrow = 44,ncol = 8) #data

wf <- c(0.0245, 0.111, 0.054, 0.079, 0.215, 0.152, 0.340, 0.0245) #ROC weight vector for females
wm <- c(0.0245, 0.152, 0.054, 0.079, 0.340, 0.111, 0.215, 0.0245) #ROC weight vector for males

cb <- c('max','max', 'max', 'max', 'max', 'max', 'max', 'max') #objective funtion

TOPSISLinear(d,wf,cb) # results for females
TOPSISLinear(d,w,cb) # results for males

##### Exporting Results to Excel #####

resultsf <- TOPSISLinear(d,wf,cb)
resultsm <- TOPSISLinear(d,w,cb)

if (!require(c("readxl","writexl"))){install.packages(c("readxl","writexl"))}
library(writexl)
write_xlsx(resultsf, "~/Desktop/for R.xlsx") #change path to xlsx output
write_xlsx(resultsm, "~/Desktop/for R.xlsx")

#----- FIELD OF STUDY -----#

# Social Sciences
```

```

wss <- c(0.054, 0.095, 0.0335, 0.095, 0.2775, 0.152, 0.2775, 0.0155) #ROC weight vector for social science
resultsss <-TOPSISLinear(d,wss,cb)
write_xlsx(resultsss, "~/Desktop/for R.xlsx")

# Natural Sciences
wns <- c(0.054, 0.152, 0.095, 0.095, 0.215, 0.016, 0.340, 0.033)
resultsns <-TOPSISLinear(d,wns,cb)
write_xlsx(resultsns, "~/Desktop/for R.xlsx")

# Formal Sciences
wfs <- c(0.016, 0.095, 0.054, 0.095, 0.34, 0.152, 0.215, 0.033)
resultssf <-TOPSISLinear(d,wfs,cb)
write_xlsx(resultssf, "~/Desktop/for R.xlsx")

# Applied Sciences
was <- c(0.0435, 0.111, 0.0435, 0.079, 0.34, 0.152, 0.215, 0.016)
resultsas <-TOPSISLinear(d,was,cb)
write_xlsx(resultsas, "~/Desktop/for R.xlsx")

#####
#----- VIKOR -----#
#####

rm(list=ls()) #clear environment

if (!require(MCDM)){install.packages("MCDM")}
library (MCDM)

d<- matrix(c( 13.4, 5.1, 0, 10.2, 19.7, 21.5, 11.4, 5.1, 18.3, 33.3, 30, 48.4, 13.4, 28.3, 11.4, 0, 19.7,
36.6, 28.3, 15.2, 30, 22.1, 0, 0, 11.4, 15.2, 16.8, 22.7, 13.4, 17.6, 0, 16.1, 5.1, 0, 0, 11.4, 27.8, 13.4, 0, 0,
25.4, 17.6, 23.8, 20.9,
0, 13.1, 0, 13.1,26.3, 18.6, 21.8, 11.4, 20.8, 27.1, 53.6, 27.6, 0, 33.1, 9.3, 14.7, 25, 21.3,
18.9, 19.5, 0, 18.6, 0, 11.4, 0, 13.1, 0, 19.7, 25.2, 9.3, 14.7, 0, 0, 0, 0, 0, 32.2,
20.8, 8, 0, 26.3, 27.1, 27.1, 0, 21.4, 39.5, 33.2, 19.2, 0, 33.2, 19.2, 16.6, 28.7, 25.3, 19.2,
0, 23.5, 0, 16.6, 0, 28.7, 25.3, 23.5, 21.4, 16.6, 16.6, 21.4, 9.6,
16.6, 16.6, 13.5, 35.8, 19.2, 28.7, 48.8, 19.2, 25.3, 28.7, 33.2, 13.5, 13.5,
19.2, 9.6, 27.1, 25.3, 16.6, 16.6, 16.6, 26.9,36.7, 31.2, 27.1, 32, 42.9, 33.4, 24.6,
34.2, 26.2, 33.4, 84.8, 19.7, 22.1, 24.7, 20.5, 35.6, 35.5, 34.9, 26.6, 25.7, 25, 25.1,
22.9, 23.9, 21.6, 23.3, 29.3, 33.7, 33, 40.2, 36.2, 28.5, 35.1, 35.2, 24.8,
28.6, 20.5, 26, 23.2, 48.6, 29.5, 27.4, 23.6, 6, 5, 8, 7, 7, 6, 6, 4, 6, 8,
4, 8, 1, 1, 1, 2, 8, 10, 9, 3, 6, 4, 8, 7, 5, 7, 4, 5, 4, 5, 8, 2, 7, 4, 5, 10,
5, 5, 7, 7, 8, 5, 3, 8, 3, 2, 3, 3, 3, 3, 3, 2, 1, 2, 3, 1, 2, 1, 1, 2, 2, 2, 1, 1,
2, 1, 1, 1, 3, 1, 2, 3, 2, 2, 2, 2, 1, 2, 3, 3, 3, 1, 1, 3, 2, 2, 3, 42.6, 44.4,
54.2, 38.9, 32.4, 44, 37.3, 35.9, 45.7, 49.3, 40.4, 40.1, 40.2, 29.9, 30.2, 30.9,
63.6, 60.3, 65.4, 47.3, 32.5, 47.1, 42.8, 39.8, 43.5, 45.3, 34.1, 45.5, 40.7, 44.6, 38.9,
33.9, 51.3, 46.6, 32.5, 53.4, 36, 30.7, 24, 32.4, 57, 42.9, 33.1, 40.8, 1, 2, 2, 2, 2, 2,
2, 2, 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 1, 3, 3, 3, 3, 3, 3, 3, 3,
1, 1, 1, 2, 2, 2, 2, 2),nrow = 44,ncol = 8) #data

wf <- c(0.0245, 0.111, 0.054, 0.079, 0.215, 0.152, 0.340, 0.0245) #ROC weight vector females
wm <- c(0.0245, 0.152, 0.054, 0.079, 0.340, 0.111, 0.215, 0.0245) #ROC weight vector males

cb <- c('max','max', 'max', 'max', 'max', 'max', 'max', 'max') #objective funtion

v <- 0.5

```

```

VIKOR(d,wf,cb,v)
VIKOR(d,wm,cb,v)

##### Exporting Results to Excel #####

resultsf <- VIKOR(d,wf,cb,v)
resultsm <- VIKOR(d,wm,cb,v)

if (!require(c("readxl","writexl"))){install.packages(c("readxl","writexl"))}
library(writexl)

write_xlsx(resultsf, "~/Desktop/for R.xlsx") #change path to xlsx output
write_xlsx(resultsm, "~/Desktop/for R.xlsx")

#----- FIELD OF STUDY -----#

# Social Sciences
wss <- c(0.054, 0.095, 0.0335, 0.095, 0.2775, 0.152, 0.2775, 0.0155)
resultss <- VIKOR(d,wss,cb,v)
write_xlsx(resultss, "~/Desktop/for R.xlsx")

# Natural Sciences
wns <- c(0.054, 0.152, 0.095, 0.095, 0.215, 0.016, 0.340, 0.033)
resultns <- VIKOR(d,wns,cb,v)
write_xlsx(resultns, "~/Desktop/for R.xlsx")

# Formal Sciences
wfs <- c(0.016, 0.095, 0.054, 0.095, 0.34, 0.152, 0.215, 0.033)
resultsfss <- VIKOR(d,wfs,cb,v)
write_xlsx(resultsfss, "~/Desktop/for R.xlsx")

# Applied Sciences
was <- c(0.0435, 0.111, 0.0435, 0.079, 0.34, 0.152, 0.215, 0.016)
resultsas <- VIKOR(d,was,cb,v)
write_xlsx(resultsas, "~/Desktop/for R.xlsx")

#####
#----- WASPAS -----#
#####

#----- GENDER -----#
rm(list=ls()) #clear environment

if (!require(MCDM)){install.packages("MCDM")}
library(MCDM)

d<- matrix(c( 13.4, 5.1, 0, 10.2, 19.7, 21.5, 11.4, 5.1, 18.3, 33.3, 30, 48.4, 13.4, 28.3, 11.4, 0, 19.7,
36.6, 28.3, 15.2, 30, 22.1, 0, 0, 11.4, 15.2, 16.8, 22.7, 13.4, 17.6, 0, 16.1, 5.1, 0, 0, 11.4, 27.8, 13.4, 0, 0,
25.4, 17.6, 23.8, 20.9,
0, 13.1, 0, 13.1, 26.3, 18.6, 21.8, 11.4, 20.8, 27.1, 53.6, 27.6, 0, 33.1, 9.3, 14.7, 25, 21.3,
18.9, 19.5, 0, 18.6, 0, 11.4, 0, 13.1, 0, 19.7, 25.2, 9.3, 14.7, 0, 0, 0, 0, 32.2,
20.8, 8, 0, 26.3, 27.1, 27.1, 0, 21.4, 39.5, 33.2, 19.2, 0, 33.2, 19.2, 16.6, 28.7, 25.3, 19.2,
0, 23.5, 0, 16.6, 0, 28.7, 25.3, 23.5, 21.4, 16.6, 16.6, 21.4, 9.6,
16.6, 16.6, 13.5, 35.8, 19.2, 28.7, 48.8, 19.2, 25.3, 28.7, 33.2, 13.5, 13.5,

```

```

19.2, 9.6, 27.1, 25.3, 16.6, 16.6, 16.6, 26.9, 36.7, 31.2, 27.1, 32, 42.9, 33.4, 24.6,
34.2, 26.2, 33.4, 84.8, 19.7, 22.1, 24.7, 20.5, 35.6, 35.5, 34.9, 26.6, 25.7, 25, 25.1,
22.9, 23.9, 21.6, 23.3, 29.3, 33.7, 33, 40.2, 36.2, 28.5, 35.1, 35.2, 24.8,
28.6, 20.5, 26, 23.2, 48.6, 29.5, 27.4, 23.6, 6, 5, 8, 7, 7, 6, 6, 4, 6, 8,
4, 8, 1, 1, 1, 2, 8, 10, 9, 3, 6, 4, 8, 7, 5, 7, 4, 5, 4, 5, 8, 2, 7, 4, 5, 10,
5, 5, 7, 7, 8, 5, 3, 8, 3, 2, 3, 3, 3, 3, 3, 2, 1, 2, 3, 1, 2, 1, 1, 2, 2, 2, 1, 1,
2, 1, 1, 1, 3, 1, 2, 3, 2, 2, 2, 2, 1, 2, 3, 3, 3, 1, 1, 3, 2, 2, 3, 42.6, 44.4,
54.2, 38.9, 32.4, 44, 37.3, 35.9, 45.7, 49.3, 40.4, 40.1, 40.2, 29.9, 30.2, 30.9,
63.6, 60.3, 65.4, 47.3, 32.5, 47.1, 42.8, 39.8, 43.5, 45.3, 34.1, 45.5, 40.7, 44.6, 38.9,
33.9, 51.3, 46.6, 32.5, 53.4, 36, 30.7, 24, 32.4, 57, 42.9, 33.1, 40.8, 1, 2, 2, 2, 2, 2,
2, 2, 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 1, 3, 3, 3, 3, 3, 3, 3, 3, 3,
1, 1, 1, 2, 2, 2, 2, 2), nrow = 44, ncol = 8) #data

wf <- c(0.0245, 0.111, 0.054, 0.079, 0.215, 0.152, 0.340, 0.0245) #ROC weight vector females
wm <- c(0.0245, 0.152, 0.054, 0.079, 0.340, 0.111, 0.215, 0.0245) #ROC weight vector males

cb <- c('max', 'max', 'max', 'max', 'max', 'max', 'max', 'max') #objective function

lambda <- 0.5

WASPAS(d, wf, cb, lambda) #Female results
WASPAS(d, wm, cb, lambda) #Male results

##### Exporting Results to Excel #####

resultsf <- WASPAS(d, wf, cb, lambda)
resultsm <- WASPAS(d, wm, cb, lambda)

if (!require(c("readxl", "writexl"))){install.packages(c("readxl", "writexl"))}
library(writexl)

write_xlsx(resultsf, "~/Desktop/for R.xlsx") #change path to xlsx output
write_xlsx(resultsm, "~/Desktop/for R.xlsx")

#----- FIELD OF STUDY -----#

# Social Sciences
wss <- c(0.054, 0.095, 0.0335, 0.095, 0.2775, 0.152, 0.2775, 0.0155)
resultss <- WASPAS(d, wss, cb, lambda)
write_xlsx(resultss, "~/Desktop/for R.xlsx")

# Natural Sciences
wns <- c(0.054, 0.152, 0.095, 0.095, 0.215, 0.016, 0.340, 0.033)
resultns <- WASPAS(d, wns, cb, lambda)
write_xlsx(resultns, "~/Desktop/for R.xlsx")

# Formal Sciences
wfs <- c(0.016, 0.095, 0.054, 0.095, 0.34, 0.152, 0.215, 0.033)
resultfs <- WASPAS(d, wfs, cb, lambda)
write_xlsx(resultfs, "~/Desktop/for R.xlsx")

# Applied Sciences
was <- c(0.0435, 0.111, 0.0435, 0.079, 0.34, 0.152, 0.215, 0.016)
resultas <- WASPAS(d, was, cb, lambda)
write_xlsx(resultas, "~/Desktop/for R.xlsx")

```



```
#####
#----- DEA -----#
#####

rm(list=ls())

library(readxl)
deaall <- read_excel("deaall.xlsx")
View(deaall)

#install.packages('dplyr')
library(dplyr)
inputall<- select(deaall,'ALUMNI','AWARD','HiCi','PCP','ACCESS')
outputall <- select(deaall,'EMPL','INTRN','TCHNG')

# DEA Model
#install.packages('rDEA')
library(rDEA)
dea_all <- dea(XREF=inputall, YREF=outputall, X=inputall[,], Y= outputall[,],
model="output",RTS="variable")
dea_all

# Results
#install.packages('knitr')
library(knitr)
results <- cbind(round(dea_all$thetaOpt,4), round(dea_all$lambda,4))
rownames(results) <- deaall$Institution
colnames(results) <- c("Efficiency",rownames(results))
kable(results[,])
```